## REMARKS

The remainder of this amendment is set forth under appropriate subheadings for the convenience of the Examiner.

Amendments to the Specification

Pursuant to comments made by the Examiner, the Abstract has been amended to consist only of a single paragraph, and portions of the Specification containing blank references to U.S. patent applications have been amended to include the missing information.

Rejection of Claims Under 35 U.S.C. § 112 Second Paragraph

Claims 34 through 36 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. In particular, the Examiner stated that Claim 34 is indefinite because the statement that the membrane is less than about three times the diameter of the largest pore of the porous substrate is not clear. Claims 35 and 36 stand rejected for depending from a rejected parent claim.

Claim 34 has been amended to more particularly point out that the thickness of the dense gas-selective membrane is less than about three times the diameter of the largest pore of the porous substrate. Support for this amendment to Claim 34 can be found in the specification at page 19, lines 1-14 which provide examples of embodiments of the claimed subject matter. Specifically, the specification states, at page 19 lines 2-7:

> In one embodiment, the composite gas separation module includes a dense gas-selective membrane wherein the dense gas-selective membrane is less than about three times the diameter of the largest pore of the porous substrate. For example, the thickness of the dense gas-selective membrane can be less than about 2.5, 2, or less than about 1.5 times the diameter of the largest pore of the porous substrate.

Since the supporting examples for the language of Claim 34 all refer to the thickness of the gas-selective membrane, it is self-evident that the language referenced by the Examiner also is directed to the thickness of the dense gas-selective membrane.

As amended, Claim 34, and Claims 35 and 36, which depend from Claim 34, particularly point and distinctly claim the subject matter which the Applicants regard as the invention and, therefore, these claims meet the requirements of 35 U.S.C. § 112, second paragraph.

Rejection of Claims Under 35 U.S.C. § 102(e) in View of Uemura *et al.* (2004/0037962 A1)

Claims 1-6, 14-22 and 26-48 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Uemura *et al.* (2004/0037962 A1). In particular, the Examiner stated that Uemura *et al.* teach a composite gas separation module formed by a process comprising forming a membrane layer of palladium over a porous support and selectively repairing pin holes or other defects in the membrane by supplying a solution of palladium through one surface of the structure and supplying a reducing gas-selective solution containing a reductant onto the other surface to form a thin film of palladium in the pin holes or defects.

Independent Claims 1 and 40 have been amended to specify that the step of selectively surface activating a coated substrate proximate to a defect in the coated substrate includes forming a layer on the coated substrate at the defect that chemically reduces a gas-selective metal component of a liquid activation composition, and subsequently applying the liquid activation composition to the layer, thereby forming at least one selectively surface activated region of nuclei on the coated substrate, wherein the nuclei include a gas-selective metal. Support for these amendments to independent Claims 1 and 40 can be found in the Specification at page 24, line 4 through page 26, line 19. "Selective surface activation" is defined generally in the specification at page 10, lines 5-10:

> "Surface activation," "general surface activation" and "selective surface activation," as used herein, include deposition of one or more materials on a surface to encourage deposition of one or more subsequently applied materials. In one embodiment, metal nuclei, such as palladium nuclei, are deposited on a surface to encourage deposition of subsequently applied material (*e.g.*, the first or second materials). For example, a liquid activation composition, described *infra*, can be used to deposit metal nuclei on a surface.

As further described at page 10, lines 16-20:

> "Selective surface activation" includes, for example, depositing metal nuclei on a surface in a targeted or tailored manner. For example, in one embodiment, selectively surface activating the coated substrate proximate to the defect includes depositing metal nuclei proximate to the defect (*e.g.*, within the defect) but not generally over the membrane-side of the support.

An example of a liquid activation composition is described at page 24, line 24 through page 25, line 9. As described therein a liquid activation composition of aqueous stannous chloride ($SnCl_2$) and palladium chloride ($PdCl_2$) is applied by first immersing a support including a coated substrate including at least one defect in an aqueous acidic $SnCl_2$ bath, and thereafter immersing in the same support in aqueous acidic $PdCl_2$. Immersion of the substrate containing the defect in $SnCl_2$ is followed by rinsing with water, such as deionized water, whereby stannous ions on the surface of the support can be partially hydrolyzed to form relatively-insoluble products, such as $Sn(OH)_{1.5}Cl_{0.5}$ and other more complicated hydroxyl-chlorides. As stated in the specification at page 25, lines 13-19, the hydrolysis product is believed to bind strongly to the surface of the substrate containing the defect to form a layer on the order of a few angstroms that reduces $Pd^{2+}$ ions from the $PdCl_2$ bath to $Pd^0$ to form nuclei or seeds of the gas-selective metal (Pd) on the surface of the support:

> The products of hydrolysis [$Sn(OH)_{1.5}Cl_{0.5}$] can be strongly attached to the surface as a layer having a thickness on the order of a few angstroms. The composition, structure, and thickness of this layer can depend on factors such as the ratio of hydrochloride to stannous chloride, the structure, roughness and shape of the support surface, and the hydrodynamic regime of rinsing. This layer is thought to reduce the $Pd^{2+}$ ions from the $PdCl_2$ bath to $Pd^0$ to form the nuclei or seeds on the surface of the support.

Nuclei formed by surface activation facilitate subsequent formation of a palladium membrane that cures the defect of the coated substrate. For example, as stated at page 25, where subsequent formation of the gas-selective membrane is by electroless plating, nuclei of the metal at the defect formed by surface activation can reduce the induction period of the autocatalytic process at the start of electroless plating:

> Thus, the surface activated support can include a structure having a number of thin layers of palladium nuclei, each formed after performing a surface activation process (such as by treating the support with $SnCl_2$ and then with $PdCl_2$). These preseeded palladium nuclei can reduce the induction period of the autocatalytic process at the start of electroless palladium plating.

As stated by the Examiner, Uemura *et al.* teach repairing pin holes or other defects in a membrane layer by supplying a solution containing palladium through one surface of a structure and supplying a reducing gaseous solution containing a reductant onto the other surface to form a thin film of palladium in the pin holes or the defects. However, Uemura *et al.* do not teach surface activation, as that term is employed by Applicants. Specifically, Uemura *et al.* do not teach or suggest surface activation of any surface prior to formation of palladium deposits. There is no teaching or suggestion in Uemura *et al.* of forming a layer on a coated substrate at a defect in the coated substrate that chemically reduces a gas-selective metal component of a liquid activation composition, and subsequently applying the liquid activation composition to the layer, thereby forming at least one selectively surface activated region of nuclei on the coated substrate, wherein the nuclei includes the gas-selective metal, as claimed by Applicants in amended independent Claims 1 and 40.

Independent Claims 1 and 40 are novel in view of Uemura *et al.* under 35 U.S.C. § 102(e). Claims 2-39 and 41-48 depend directly or indirectly from independent Claim 1 or independent Claim 40. Therefore, these claims also are not anticipated by the teachings of Uemura *et al.* under 35 U.S.C. § 102(e).

Rejection of Claims Under 35 U.S.C. § 102(e) as Being Anticipated by Edlund et al. (2002/0083829)

Claims 1-6, 15, 22, 26-43 and 48 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Edlund *et al.* (2002/0083829). In particular, the Examiner stated that Edlund *et al.* teach a composite gas separation module formed by a process comprising forming a membrane layer of palladium or Pd-Cu alloy over a porous support that can be ceramic or stainless steel

alloys containing Cr, Ni and/or Mo, and repairing defects in the membrane by spot-electroplating or by using a photolithographic method.

Edlund *et al.* is directed to an etching process for selectively reducing the thickness of a hydrogen purification membrane. For example, Edlund *et al.* teach that a roll-formed foil membrane can be selectively etched to reduce the thickness of a selective portion of the foil. In some instances, such as when the etching is not properly controlled, holes can appear in the membrane and there is a need to repair such holes. The method described by Edlund *et al.* involves covering the portions of the foil that are not to be repaired with a mask. The holes are sealed by conventional methods without "surface activation."

Edlund *et al.* do not teach or suggest a method comprising (a) depositing a first material over a porous substrate, thereby forming a coated substrate, wherein the coated substrate contains at least one defect; (b) selectively surface activating the coated substrate proximate to the defect by forming a layer on the coated substrate at the defect that chemically reduces a gas-selective metal component of a liquid activation composition, and subsequently applying the liquid activation composition to the layer, thereby forming at least one selectively surface activated region of nuclei on the coated substrate, wherein the nuclei includes the gas-selective metal; and (c) preferentially depositing a second material on the selectively surface activated region of the coated substrate, whereby the defect is cured, as stated in Applicants' amended independent Claims 1 and 40. For instance, Edlund *et al.* do not teach or suggest depositing a first material over a porous substrate, thereby forming a coated substrate, wherein the coated substrate contains at least one defect.

Edlund *et al.* do not teach or suggest selectively surface activating the coated substrate proximate to a defect, as stated in amended independent Claims 1 and 40. Instead, Edlund *et al.* teach covering areas of a foil membrane that are not in need of repair, followed by conventional deposition techniques, such as spot electroplating or electroless plating. Therefore, Edlund *et al.* do not teach Applicants' claimed method, as set forth in amended Claims 1 and 40, nor the claims that depend from them. Accordingly, Applicants' claimed invention meets the requirements of 35 U.S.C. § 102(e) in view of Edlund *et al.*

Allowable Subject Matter

Applicants acknowledge the Examiner's statement with respect to Claims 7-13 and 23-25 as objected to for being dependent upon a rejected base claim but would be allowable if rewritten in independent form, including all the limitations of the base claim and any intervening claims.

Information Disclosure Statements

Applicants filed a Supplemental Information Disclosure Statement (IDS) on January 31, 2005, but have not received an acknowledgement copy of page 3 of the Supplemental IDS. Applicants respectfully request that the Examiner consider the provisional patent application cited therein and provide an initialed copy of page 3 of the January 31, 2005, Supplemental IDS in the next correspondence.

In addition, Applicants are submitting herewith an additional Supplemental Information Disclosure Statement. Applicants request that the Examiner consider the references cited in this new IDS.

## SUMMARY AND CONCLUSIONS

The Specification has been amended as suggested by the Examiner. Dependent Claim 34 has been amended to more particularly point out and distinctly claim the subject matter which Applicants regard as the invention, thereby conforming dependent Claim 34 and dependent Claims 35 and 36 to the requirements of 35 U.S.C. § 112, second paragraph. Applicants have also amended independent Claims 1 and 40 which, as amended, meet the requirements of 35 U.S.C. § 102(e) in view of Uemura *et al.* and Edlund *et al.* Accordingly, remaining dependent claims also meet the requirements of 35 U.S.C. § 102(e).

Applicants respectfully request reconsideration and withdrawal of all the outstanding objections and rejections of the specification and claims. If the Examiner believes that a telephone conference would expedite prosecution of this case, he is invited to call Applicants' undersigned attorney.

Respectfully submitted,

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